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AUTHOR Lawrence, Jeanette; And Others
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ABSTRACT

This research addresses the actual goals and intentions from which students plan and organize their work in a course of study. Representations can either facilitate or hinder learning and problem solutions. Several salient aspects of adult students' representational systems and how they influenced university study were examined in two studies. The first study investigated how four mature aged students represented their work on a university-level advanced course in educational psychology. Students' goals were directly related to individualized plans for working on the course, but none agreed with the kinds of goals and objectives that were written into the course materials. There was a strong tendency for planning strategies to reflect major goals. Organization, selection, and reading plans were developed in the service of pre-determined purposes. The second study, of relations between goals and working plans, also sought to develop profiles of students' representations of a complex study task over time. Active and reflective abstractions and re-organization was related to better learning outcomes. Better students indicated they would continue developing perspectives while poorer students maintained their more rigid theories about course demands and effective strategies. They did not acquire new understanding or skills for using learning theories. (PN)

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"YOU TELL ME YOUR THEORY AND I'LL TELL YOU MINE":
STUDENT'S AND INSTRUCTOR'S REPRESENTATIONS OF PROBLEMS

Jeanette Lawrence, Simone Volet & Agnes Dodds, Murdoch University, WA.
and Barry McGaw, A.C.E.R., Hawthorn, Vic.

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A major task of problem oriented instruction is to train students to think about problems with perspectives appropriate to their discipline. In initial training, recruits are introduced to the mysteries of thinking like a doctor or an engineer, and the accepted ways of operating on professional problems. In continuing education, previously acquired knowledge and skills are sharpened and refined in practitioners. Professional education is designed to help budding and competent problem solvers to acquire and use the kinds of mental representations that produce expert and imaginative solutions.

The significance of attaining professionally-relevant knowledge and perceptions is reflected in in-house jokes and asides that are told and re-told at conventions and informal gatherings, and that drive outsiders wild. Although "thinking like a -(any profession)" can simply involve adopting the right jargon and blind spots, acquiring accepted ways of conceptualising and setting up one's inquiry and search is an important part of professional education. Learning how to process information from appropriate mental schemas indicates at least professional socialization, and at best the intelligent, flexible understanding which lies behind successful problem solutions in a chosen field (Larkin, 1982).

It is easy for instructors who are well grounded in their disciplines to make some gross and erroneous over-estimations about how readily students can interpret problem tasks, and work from appropriate ideas and assumptions. Our title envisages instructors who want to understand how students conceptualise and mentally represent problems. Such instructors will be keen to compare what some researchers call students' "implicit theories"(Goodnow, 1980; Wegner & Vallacher, 1977) with the formal theories of their disciplines, and with their own instructional concepts and assumptions.

WHAT IS MEANT BY "STUDENTS' REPRESENTATIONS"?

Individuals' existing knowledge, beliefs and attitudes shape the expectations that in turn guide their conceptualizations of problems and their strategies for handling them. Incoming messages are mentally transformed so that they can be dealt with from perspectives and concepts already in the problem solver's memory. The term "representation" may be used for the whole process by which an individual conceptualises and interprets a problem task, or for the existing mental schemas or implicit theories brought to the task, or it may be reserved for the final mental model that is constructed to generate an appropriate solution (Larkin, 1982; McGaw & Lawrence, 1984).

Sometimes researcher's terminologies reflect interest in the source of mental representations of problems, and sometimes they reflect the exactness with which that researcher wishes to describe representation in action. For example, the social and cultural influences on Goodnow's subjects' implicit theories of child-rearing are more important for her interest in parents' expectations than the logical links Chi draws between physicists' knowledge structures, or schemas, and their specific solutions of problems (Chi, Glaser & Rees, 1982). Nevertheless, despite differences in terminology and emphasis, there are some common assumptions about what people's mental representations do in a problem situation.

The weight of evidence indicates that expert problem solvers differ from novices in how they perceive and set up problem situations, acquire and interpret new information, and generate solution processes and outcomes (Chi, et al., 1982; Larkin, 1982; Lesgold, in press; Lawrence, in press). In addition to analyses of scientific and computational problems, work on open-ended problems has shown

that the goals and values in representational systems also distinguish expert from novice, and efficient from inefficient working plans, reasoning structures, and problem solution moves (Lawrence, in press; Volet, Lawrence and Dodds, 1985; Voss, Greene, Post & Penner, 1983).

Representations of novices are less abstract than those of experts who use their rich knowledge to transform the problem to more workable forms. Confronted with a difficult problem, experts spend time developing appropriate qualitative models before moving to any solutions. Although novices' solutions, too, are driven by their cognitive structures and not just by the problem, their structures are less complete, less coherent and at a lower level of abstraction. Therefore their mental perceptions and constructions are less useful in suggesting productive routes to take.

So, we would argue that people's representational systems, and particularly students' in problem situations, will demonstrate the effects of their schemas and theories in ways that are significant for their instructors. Instructors can expect that students' theories will influence what they see and attend to, how they interpret concepts and disciplinary language, how they organise basic and advanced materials, and generate solutions and errors. In particular our research addresses the actual goals and intentions from which students plan and organize their work in a course of study. Representations can either facilitate or hinder learning and problem solutions. In two studies we examined several salient aspects of adult students' representational systems and how they influenced university study.

STUDENTS' VERSUS INSTRUCTOR'S GOALS AND PLANS

The first study (Dodds and Lawrence; 1983) investigated how four mature aged students represented their work on a new advanced course in educational psychology. Studying a new course is a particular type of problem, and its difficulties are exacerbated for external students. With new content and distances between instructor and students, it becomes important for instructors to find out if their representations of content and methods of study are shared by students.

There is little in-depth research on students' expectations, goals and plans for everyday but important tasks like successfully learning new material, so we went back to Piaget's (1975) clinical interviews with children, and the idea of chasing through a conversation for information on particular questions. The data were qualitative and verbal, and the focus was on students' goals and plans. In addition, we used a "think aloud" concurrent report of each student's opening of her course work package. (Ericsson & Simon, 1984).

Students' goals were directly related to individualized plans for working on the course, but none agreed with the kinds of goals and objectives that were written into the course materials. Table One compares the instructor's goals and assumptions with two types of students'.

TABLE ONE ABOUT HERE

Two students' goals involved meeting assessment and formal course requirements. Two were most concerned with their own personal interests and immediate needs. Following identification of objectives each student was asked how she planned her work in general, and in relation to the new course materials and the requirements on her course package. Two general questions were followed up with probes to find out goals and plans, "How do you go about planning the work?" "Do you make conscious decisions?" As a student opened course materials, she was asked to think out loud while she examined the study guide, course materials booklet and other written information and directions. She could make any spontaneous comments she wished. Each student's perceived planning strategies were abstracted out of the comments, and they are most informative when juxtaposed with expressed goals.

The two students who were assessment oriented said they would plan the semester's work around assignment topics and dates. One said she usually chose her assignment topics before even beginning to study. The other added that she planned to check her responses against the lecturer's stated objectives. In the previous course she thought she was doing well until an unsatisfactory examination performance. That was due to her misunderstanding of the lecturer's emphases she felt, and she was determined not to repeat that experience.

Interest oriented students acknowledged the need to keep up motivation. While they also made logistical plans around assignment dates, they both made the qualification "I probably wouldn't stick to them", and they didn't. One said she would select and read topics and papers for their interest value. The rest would be summarized and "skimmed". For the other, if content failed to sustain her interest she would simply "send it (the course) back". Selectivity prevailed in her intentions.

There was a strong tendency for planning strategies to reflect major goals. Organization, selection and reading plans were developed in the service of pre-determined purposes.

While educators may try to keep their goals and ideas clear so that students can share their informal theories of the work, they may face students' rejection of their precious assumptions, and students' adoption of alternative theories. Instructional and learning representations may not coincide. The particular course was designed with the intention of exposing students to new ideas and theories, and encouraging them to build appropriate thought patterns and processing skills, by working through a sequence of topics. The students planned to take this single package apart to suit their own interests and agendas.

PROFILES OF STUDENT REPRESENTATIONS

A follow-up study (Volet, 1985), of relations between goals and working plans, also sought to develop profiles of students' representations of a complex study task, over time. In a dynamic activity like studying over time in a new area, it is important to look at the links between students' intentions and their working plans and abstractions. We would expect that intake of new information would modify prior schemas, and that prior schemas would structure learning.

Five women volunteers in the ninth week of a 13 week educational psychology course, were interviewed three times, over six weeks. In an initial, clinical interview, each student was asked her goals and objectives for the next four weeks' study, her perceptions of any difficulties and problems, intentions to

overcome those difficulties and her working plans for studying the course. The second session involved a "study demonstration" using the student's own materials and notes on the last lecture topic on psychodynamic theories. The student demonstrated how she would study this topic. She could refer to and use the course materials, textbook and her own lecture and study notes. Third interviews of four subjects took place within the week after the final examination, with the three subjects to attend. Clinically probed questions were structured around perceptions of activities each student had found useful in working on the course, and any effective strategies she would keep in mind for future courses.

The use of different occasions and stimuli for obtaining data on students' representations strengthens the descriptions and explanations we can make, especially with a complex, on-going task like studying. The method was similar to the first study's, with an additional category on students' perceptions of difficulties, and the simulated study demonstration. Of course the more data one collects on an individual subject, the more difficult it is to present the complex profile of that subject's representations of tasks. Lawrence (in press) developed a scheme for setting out several subjects' expressions of key concepts in interviews. Original data were magistrates' selections of file information on criminal offenders, and their inferences and decisions about sentences. A similar scheme shows the key concepts in the five students' representations in Table Two.

TABLE TWO ABOUT HERE

The table shows differences and similarities in representational systems of high achieving and low achieving students. Three students achieved high marks on the final examination, and two barely passed. Key concepts expressed by individual high and low achievers appear as patterns of plus marks. Blanks indicate when a student made no mention of a concept. Reading across the rows shows similarities and differences in the five students' goals, perceived difficulties, plans, procedures and emphases. Reading down each student's column gives a picture of her overall way of representing her study over time. The numbered sections mark off the three separate interviews.

High achievers' (HA1,2 & 3) goals were quite different from the low achievers'(LA4 &5) in their orientation to the study task, and to themselves as learners. High achievers mostly were interested in understanding and integrating material while one low achiever (LA4) wanted to pass the compulsory course and the other (LA5) was concerned with remembering material for the examination. Adopting the spirit of the course, two high achievers wanted to develop their own theories to guide their professional development and practice. They said,

I think the point of it is obviously to help me become a better teacher by understanding how students learn um, if I can develop my own theory of learning that should be able to help me in the classroom. (HA1)

What I'm saying, the practical and the theory combined together is going to be most important too, to do that. So I just don't regurgitate a whole lot of facts but rather some of the facts that I've learned can be applied. (HA2).

These two able students emphasised understanding, drawing together for themselves major concepts and applying them to educational experiences. Their perspectives were quite different from LA4's personal educational objectives of finding out more about the theory her future employers would be using. Her aim was receptive, their's involved active construction.

Perhaps the differences are more marked in the kind of difficulties that high and low achievers thought would hinder their success. Better students concentrated on task-related problems, but poorer students on personal problems. High achievers mentioned external or contextual constraints like the new concepts to learn, volume of work, and shortage of time. Low achievers bemoaned their anxieties and inabilities to express themselves.

Working plans of the high achievers were expressed as re-organization and application of information, while low achievers focussed more on receiving, than using information. Learning strategies revealed in students' demonstrations of study supported the expression of two different sets of working plans. All students said they would concentrate on key concepts and four mentioned that overviews of the material were essential. Only high achievers said they would build up their own overviews, while LA4 only discussed making use of the overview already provided for her. LA5 made no reference to overviews, a major feature of the course. Only more able students' comments contained distinct references to reflective integration and application processes, (e.g., "I would need to think about the problems with his theory..also ..about the educational implications of the theory" HA1).

Flexible, adaptive behaviours distinguished high from low achievers. All except HA1 said they would use some rote learning strategies for exam preparation, yet the post-exam interviews revealed that only low achievers still found this essential. High achievers stressed integration procedures instead. Earlier, HA2 predicted she would rote learn, but she had changed her perceptions by the end of the course. This student also reported that an early class test made her realize what was the whole orientation of the course, and she adapted to it, "It does in fact say you have to apply it, and I think I haven't done that as much as what I could have" (HA2). This kind of reflective and adaptive approach contrasted with LA5's inability to be "objective", she said. In fact, she was describing her lack of flexibility, "It's sort of preset inside me, I don't chose and say 'I'm going to do this'".

Profiles revealed differences in representational systems of women who were proficient learners, and of women whose performance was barely adequate. Active and reflective abstraction and re-organization was related to better learning outcomes. Better students gave the impression that they would continue developing perspectives appropriate for professional teachers. Poorer students, in contrast, came with more rigid theories about course demands and effective strategies. They did not acquire new understanding or skills for using learning theories in their teaching.

CONCLUSION

The two studies illustrate variations that can occur in student and instructor, or student and student, representations of a common task. Yet, some discernible trends revealed that such variations in expectations and perceptions were associated with differences in learning processes. If students do not operate from

the same assumptions and goals as their instructor, then they are unlikely to learn what their instructors hope for. Yet, even students who do not naturally share their instructor's representations, can come to realize them and the task demands they suit. Inflexible and unchallenged student theories issue in limited strategies and short-circuit learning. If better learning outcomes are associated with different expectations and perceptions, as our data suggest, then diagnosing and confronting inappropriate theories may be important aspects of problem-oriented teaching.

We can go a little further than simply stating that theories influence plans and work. Student perceptions of possible hurdles, like their orientations provide some useful places to search for learning difficulties. Initial misinterpretations caused syllogistic errors in Revlis' (1975) subjects' logic problem solving. Novice radiologists could not make out the bodies that experts "saw" in the same X-Ray pictures (Lesgold, 1982). The learning of Fischer and Mandl's (1984) subjects was inhibited when they concentrated on themselves rather than their tasks. Educators should know about the blocks, anxieties and misconceptions that interfere with creative problem solving. Maladaptive representations can pull against the kinds of skills and strategies one hopes to induce in novices.

Problem solvers become more expert as they acquire knowledge, and construct working theories that match puzzling phenomena. Observing constructive and adaptive processes over time and multiple data points can build dynamic pictures of students' initial and developing representations of tasks. Teachers who can observe and know how their students represent problems, have better chances of tailoring instruction to professional goals and student needs. After the first study, the instructor could intervene more directly in teaching students to abstract, integrate and reflect. This worked for some students, although at least two

slipped through the training net. It would be useful to know what theories guide failing students, and students with dramatic shifts in processing.

Talking through student and instructor theories earlier may avoid later remedial work. It is not sufficient to specify the formal theories that a student must know. Diagnosis of agreements and disagreements in theories belonging to the discipline, the instructor and the student is a basis for turning beginners, not into instant experts, but into competent novices who can adapt to the demands of their professions.

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Table One : Instructor and Student Representations of Coursework

	<u>Representation</u>		
	Instructor	Student Type One	Student Type Two
GOAL	Develop new perspectives and knowledge	Meet assessment requirements	Follow personal interests and needs
			
WORKING PLANS	Read and research topics sequentially, integrate	Select topics, work around assignments and dates	Select topics, work from personal interests

Table Two: High and Low Achieving Students' Representations of a Course

	Student				
	HA1	High Achieving HA2	HA3	Low Achieving LA4	LA5
1. CLINICAL INTERVIEW					
GOALS					
Task-Oriented					
Understanding,					
Integration	+	+	+		
Remembering					+
Success		+		+	
		(acceptable)		(pass)	
Self-Oriented					
Develop teaching					
theory, application	+	+			
Find out, understand					
theories				+	
PERCEIVED DIFFICULTIES					
Task-Oriented					
New material	+	+	+		
Volume of work	+	+	+		
Time	+	+	+		
Integration			+		
Writing			+	+	
Self-Oriented					
Motivational			+	+	+
			('block')	(anxious)	(anxious)
WORKING PLANS					
Reorganization of					
information	+	+	+		
Application of	+	+		+	
information					
Rote learning			+	+	+
2. DEMONSTRATION OF STUDY PROCEDURES					
Use key concepts	+	+	+	+	+
Overview Theories	+	+	+	+	
	(build)	(build)	(build)	(use)	
Understand	+	+	+		
Reflect	+	+			
Apply	+	+		+	
Rote learn		+	+	+	+
3. POST-EXAM COMMENTS ON ESSENTIAL PROCEDURES					
Integration	No	+	+		
Remembering	Interview			+	+